

## Heat Transfer in a Fluid

### Introduction

In the summer time, when temperatures start to rise, we use fans to keep ourselves cool. If we eat soup that's too hot, we blow on it to make it easier to eat. When we burn our fingers on a hot surface, we might run them under the faucet to help cool them down. But why do we do these things? This lab will attempt to look at the effects of using a moving fluid to cool a system, and relate to how these ideas are used in automotive cooling.

### Main Lesson

In this experiment, students will be introduced to the basics of heat transfer in a fluid. The first part of the lab investigates what effect the type of fluid has on the rate of cooling a heated metal object. The second part then looks at the effect of having that fluid moving instead of sitting. Through this experiment, the students should start to get an idea of how the movement of fluids like air, water and oil is used to help keep an engine cool.

### Materials Needed

For this experiment you will need:

- 4 metal spoons (or other metal items of the same material)
- 3 beakers/mugs
- Hot plate
- Thermometer
- Electric fan
- Sink
- Oven mitts/gloves
- Stopwatch

### Safety Precautions

Will need adult supervision when working with hot water.

### Instructions

1. Place 2 of the spoons in a beaker and cover with enough water to go ~2/3 of the way up the spoon.
2. Take 2 empty beakers and put them aside. Fill one with an equal amount of room temperature water as the first beaker. Leave the second beaker empty.
3. Place the beaker with the spoons on the hot plate. Turn on the hot plate and allow the water to come to a boil.
4. Using the oven mitts and the thermometer, take the spoons out of the beaker and measure their temperatures. Record these as the initial temperatures.

5. Quickly, place one spoon into each of the prepared beakers. Use the stopwatch to time out a minute.
6. Take the spoons out of the beakers and record the new temperatures. Observe how much each spoon cooled down. Compare between the air and water results.
7. Repeat steps 1 and 3 with a new set of spoons. Use the thermometer to check that the spoons reach the same temperature as in the first part.
8. Turn on the electric fan. Turn on the sink, and set it so that the water coming out is at room temperature. This can be measured using the thermometer.
9. Using the oven mitts, take the spoons out of the beaker. Record their initial temperatures.
10. Place one spoon in front of the electric fan and the other spoon under the running faucet. Use the stopwatch to measure out another minute of time.
11. Use the thermometer to measure the new temperature of each spoon. Compare the new temperatures of the moving fluids against the stationary fluids.

### **Conclusions/Take Away**

Students should notice 2 things from in experiment: water works as a better medium for transferring heat, and a moving system is much more efficient than a stationary system. These principles help to form the basis of the cooling system for a vehicle. Through convection, heat from the engine is transferred to the coolant, which is usually made of a mix of water and antifreeze. It is circulated through the system until it reaches the radiator, where the heat is taken out of the system through the movement of air across the fins of the radiator. This air flow is provided either by the radiator fans or the movement of the vehicle.